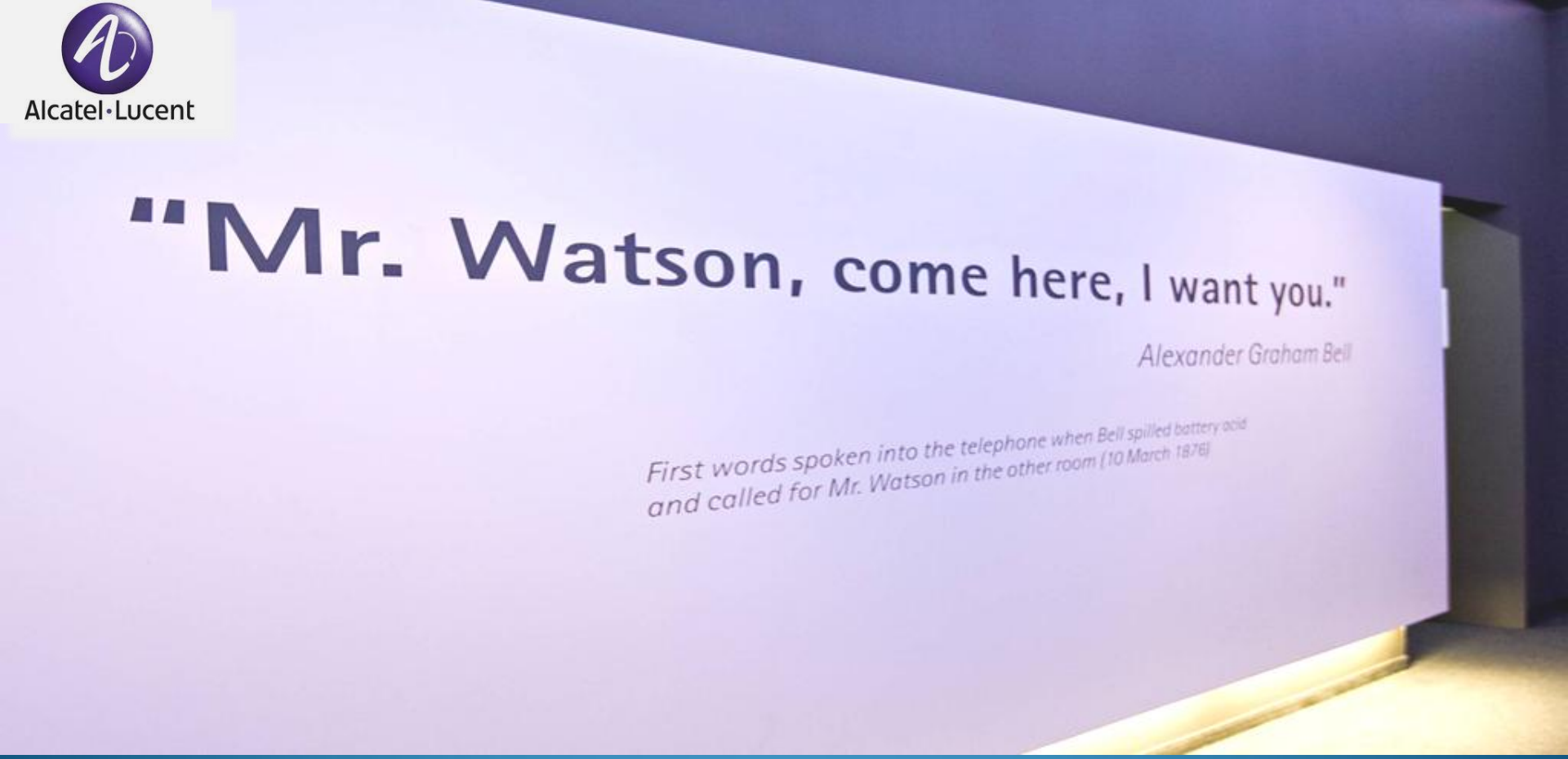


FCC Band Plan Technical Forum

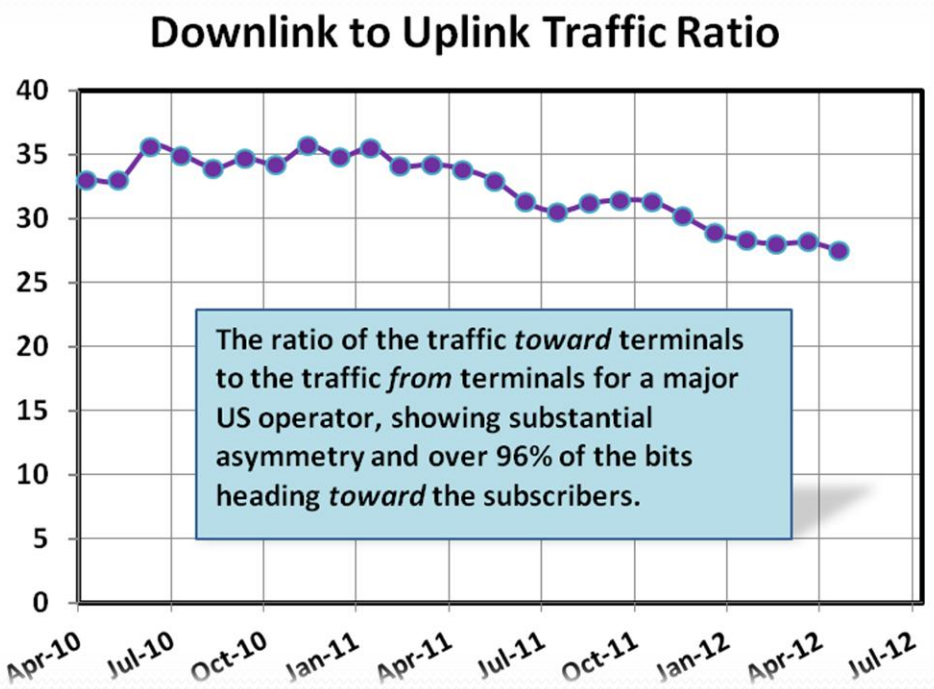
TDD and asymmetrical FDD

Stephen A. Wilkus

July 16, 2012

Downlink traffic now dominates

- Voice traffic was 1:1 Down:Up.
- Feature phones of 2005 started to see 4:1 heavier downlink data.
- Smartphones introduced in 2007 unleashed wireless data.
- Wireless Data traffic exceeded voice traffic in 2008 and has been >doubling annually since.
- Aggregate traffic is now 17 to 30 times heavier in the downlink than uplink, with exceptions…
- Super bowl 2012 had more uplink traffic than downlink.



- "Past demand is no guarantee of future results," trends are subject to change…

TDD-LTE supports some Downlink/UL ratios

- The Time Division Duplexed, TDD-LTE standard supports up to 8:1 downlink:up ratio.
- The frame configuration must be consistent within a geographic area and with frequency "neighbors."
- Like FDD-LTE, TDD-LTE supports carrier aggregation.

TDD-LTE Frame Structure

10 mSec Frame

Config.	DL/UL	SF#0	SF#1	SF#2	SF#3	SF#4	SF#5	SF#6	SF#7	SF#8	SF#9
0	**0.3**	DL	Special	UL	UL	UL	DL	Special	UL	UL	UL
1	**1.0**	DL	Special	UL	UL	DL	DL	Special	UL	UL	DL
2	**3.0**	DL	Special	UL	DL	DL	DL	Special	UL	DL	DL
3	**2.0**	DL	Special	UL	UL	UL	DL	DL	DL	DL	DL
4	**3.5**	DL	Special	UL	UL	DL	DL	DL	DL	DL	DL
5	**8.0**	DL	Special	UL	DL	DL	DL	DL	DL	DL	DL
6	**0.6**	DL	Special	UL	UL	UL	DL	Special	UL	UL	DL

DL = Downlink, UL= Uplink

Special Subframes transport pilots, gap, scheduling grants and SRS in one of 9 SSF formats, not considered here for simple traffic comparisons. TS36.922

- TDD terminals have less time to transmit their uplinks and at fixed peak power, resulting in reduced energy per bit → reduced uplink range (but better battery life). That is to say, TDD mode is highly constrained.

Carrier Aggregation permits use of unpaired spectrum

- LTE-Advanced Rel-10 (first office applications in 2013) introduces Carrier Aggregation (CA) for both HSPA and LTE.
- CA of different size and numbers of carriers, inter-band and intra-band Component Carriers.
- Downlink-only Carriers to be supported (such as Lower 700 MHz D&E blocks.)
- This provides new opportunities for unleashing stranded bands such as AWS-3, WCS, and Lower-700 MHz A block, where uplinks have been problematic.
- Methods are emerging for improving UL Spectral Efficiency, more so than DL SE.
- ➢ CA combination restrictions, complicated radios, stresses on signaling channels.